Resource Conservation Training

Motors and Compressors

MA OTA

2008

Electric Motors

- **Electric motors consume 64 % of the electricity produced in this country**
- **Electric motors represent a significant opportunity area for energy conservation.**

Electric Motors

- **Process motor systems account for 63% of all electricity used in industry**

- **Because of the national energy implications , Congress enacted the Energy Policy Act of 1992, which set minimum efficiency standards for certain classes of electric motors.**

Electric Motors

- **EPAct rules for motors became effective Oct. 24, 1997.**
- **In June 2001, NEMA granted "better-than-EPAct" motors special recognition by creating a designation called NEMA Premium™.**

Electric Motors

- **The DOE estimates there are 12.4 million motors bigger than 1 hp in service in U.S. manufacturing facilities**
- **600,000 are replaced annually.**

Electric Motors

- **Using NEMA Premium motors as replacements could save 11-18 percent of current annual electrical usage**
- **62 to 104 billion kWh per year, valued up to $5 billion**

Electric Motors

- That efficiency increase could prevent the annual release of up to 29.5 million metric tons of carbon emissions

- Equivalent to keeping 16 million cars off the road for 10 years

Electric Motors

- Replacing failed motor with a Premium unit has a straightforward return on investment.
- Energy efficiency gains offset the price differential in a short period
- Those savings continue as long as the motor remains in service.

Electric Motors
Economic Example

- **100 horsepower AC induction motor operating at standard SF 0.75 (56 kw)**
- **Two Shift Annual Operating Cost - 4000hr x 56 kw x $0.14/ kwh = $31360**

Electric Motors
Economic Example

- **Standard Motor costs approximately $8450   Baldor CM4400T**
- **Premium Motor costs approximately $10427 Baldor CEM4400T**
- **$1977 cost differential**

Engineering Data

Horsepower	Standard Efficiency	Premium Efficiency
1	78.0	82.5
2	78.5	84.0
5	84.0	89.6
10	**84.0**	**91.1**
15	87.5	91.7
25	90.2	93.0
50	91.7	94.1
100	91.7	95.0
250	94.1	95.8

Electric Motors

- **95.0% - 91.7% = 3.3%**
- **.033 x $31360/yr = $1035/yr. Savings**
- **$1977 cost differential**
- **Premium Motor Payback 1.9 yr, cost savings persist for the life**

Electric Motors
Small Motor Example

- **Changing motors solely on an energy conservation basis more beneficial with smaller motors.**

- **Ventilation Fan 10 hp motor at SF 1.0 – 24/7 operation at 7.5 kw**

Electric Motors
Small Motor Example

- **Premium $1577 Standard Motor $1280 (OEM choice)**

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Electric Motors
Small Motor Example

- **6000 hr x 7.5 kw x $0.14 = $6300/YR**

- **7.1 % Premium efficiency differential $450/yr**

Electric Motors
Small Motor Example

- **$1570 Cost, $450 annual savings**
- **Payback 3+ years with 10 year expected life.**
- **Perhaps $2700 cost avoidance over six additional years**

Which motors to Target

- Motors driving variable loads
  - Pumps
  - Hydraulic systems
  - Fans
- Motor efficiency is often poor due to operation at low loads.

Which motors to Target

- Motors scheduled for replacement
- Motors greater than ten years old

Electric Motors
Small Motor Replacement

- Compromise – Spread out the effort

- Formal program to gradually install Premium motors

Another Option

- **Variable Frequency Drives (VFD)**

- Control the speed and torque of an AC electric motor

- Vary the frequency and/or voltage of the electricity supply.

- AKA Variable Speed Drives (VSDs)

Another Option

- **VFDs** replace inefficient mechanical speed controllers:
- belts and pulleys
- throttle valves
- fan dampers
- magnetic clutches

VSDs in Use

- VSDs are proven in the food, paper, automotive and consumer goods industries.
- They're used in crushers, grinding mills, rotary kilns, presses, rolling mills and textile machinery.

VFD Advantages

- No friction loss
- No moving parts.
- Instant and precise speed control

Gentle startups and gradual slowdowns

Small size facilitates retrofit

VFD Advantages

–Energy savings up to 20 percent

Compressed Air

- Very convenient and very inefficient
- Only 10-15% electrical to mechanical energy yield.
- Widespread use in industry offers potential energy conservation options associated with the motor.

Compressed Air

- There may be more substantial opportunities in system repair and maintenance.

- Leaks
- Pressure drop

Compressed Air LEAKS

- Leaks are major source of wasted energy in compressed air systems.
- A plant may have a leak rate of 20-30% of total compressed air production capacity.

Compressed Air
LEAKS

- 1 hp yields about 3.5 SCFM at 100 psi
- A "small" leak at 1 scfm costs about **$0.75 a day** (< 1/32" dia = pencil point)
- For 24/7 activity costs $**250/year**

100 HP Motor at 75% capacity

- **Change to Premium Motor** Saves

  .033 x $31360/yr **= $1035/yr**

- **A 20% leak reduction** saves

  0.2 x $31360/yr **= $6272 /yr**

- Limited capital investment

Repair and Maintenance

- Condensate Drains- Float and electric
- Filters/Separators- saturated elements cause pressure drop that costs energy
- Pipe Fitting Leaks
- Corrosion (Pressure Drop)

Leak Detection

- Tour the plant during down time
- Storage tank pressure decay

- Ultrasonic Leak Detectors

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Pressure drop

- For every 2 PSI above need energy costs rise 1%
- Consider other point of use equipment for low pressure applications

Low Pressure High Volume

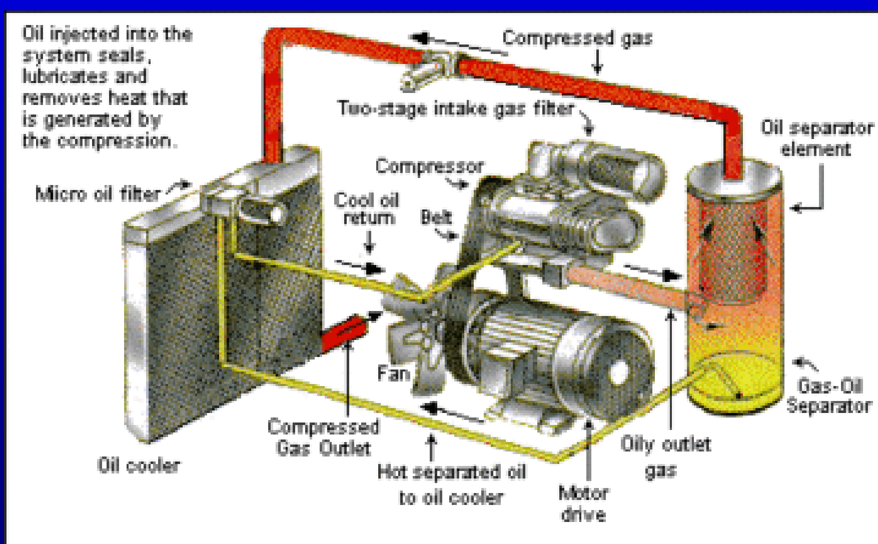
- Vane Compressors

- Regenerative Blowers

- Low Pressure Guns and Nozzles.

Screw Compressors

- For medium pressure
- Load Matching through inlet throttling and VFD speed control



Resources

- U.S. Department of Energy's Motor Challenge Program
- http://www1.eere.energy.gov/industry/bestpractices/motor_challenge_national_strategy.html
- DOE MotorMaster – Retrofit Database (with pricing!)

KNOW PRESSURE
COMPRESSED AIR CHALLENGE®

- http://www.compressedairchallenge.org/

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OTA is Here to **HELP YOU**!

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